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ABSTRACT

Presented is a resource book to be used with instructional kits for elementary school science students, grade 3. The individual units at this grade level are based on curriculum which has been developed by the National Science Foundation in the 1960s and revised to meet student and teacher identified needs in Anchorage, Alaska. Six units are included within this guide. Each unit lists kit and non-kit items, supplemental materials, teacher background information, and proposed schedule. Worksheet masters are also included. Unit topics include Electricity, Force-Motion and Machines, Weather, Sink or Float, Mystery Powders, and Plants and Animals. (CS)

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ELEMENTARY SCIENCE GUIDE

3RD GRADE

1978

SUPERINTENDENT OF SCHOOLS
ANCHORAGE SCHOOL DISTRICT
4600 DEBARR ROAD
ANCHORAGE, ALASKA 99504

SE 031 447

FOREWORD

This Resource Book has been prepared for use with instructional kits distributed through the Anchorage School District Science Center. These kits were developed by the Elementary Science Curriculum Committee under funding by ESEA Title IV B & C in response to student and teacher identified needs.

The individual units at each grade level are based on curriculum which has been developed by the National Science Foundation in the 1960's. The curriculum has been taught by thousands of teachers throughout the United States. The Anchorage School District adopted this curriculum and our Anchorage teachers have adapted it to fit our needs and our scope and sequence. The Anchorage School District is enthusiastic about this effort and believe that this guide and the Science Center will represent more effective and efficient ways of teaching science.

The process of curriculum planning and development requires the help of many teachers, principals and administrators. We appreciate the cooperation and assistance of everyone who has contributed to this project.

E.E. (GENE) DAVIS, ED.D
ASSISTANT DEPUTY SUPERINTENDENT

EED:dc

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The development of this guide represents the contribution of many talented people during the past two to three years. We are very grateful to the following people for the unique contribution each of them made in developing our science program.

The guide material was written by the following people:

1st trial edition 4-6 writing team summer 1977.

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The Highline School District - Seattle, Washington -
Chuck Hardy, Science Coordinator, has been our guiding light.

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The Minneapolis School District - Minneapolis, Minnesota -
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(To be taught in any sequence)

Electricity

Force-Motion and Machines

Weather

Sink or Float

Mystery Powders

Plants and Animals

OUTCOME STATEMENT

For Students Grades K-6 -- Science

The major outcome of science education in the Anchorage Schools is the development of scientifically literate citizens. A scientifically literate person is generally described as a person who:

- Understands enough of the fundamental concepts of the physical and biological nature of the world so that he/she may act responsibly.
- Possesses science skills and processes that give rise to facts and concepts.
- Possesses attitudes or values generally associated with science such as curiosity and respect for data.
- Uses science concepts, skills and values in making decisions as he/she interacts with other people and with his/her environment.
- Is aware of the interrelationship taht exists between cultural, philosophical, environmental, and social changes and scientific and technological advancements.

The role of the elementary school is to provide concrete, first hand experiences for students so that they may begin the process of becoming scientifically literate citizens. Because a child's mind changes in the manner it operates, and does not simply increase in capacity as it matures, the K-6 outcomes will be concrete and demand direct student observations. Nevertheless, these outcomes are important prerequisites for the later outcomes.

By the end of the sixth grade a student should be able to:

- Observe and describe a simple event using more than one sense.
- Record and share observations with others.
- Classify a set of objects.
- Collect and organize simple data.
- Interpret the meaning of simple data
- Set up a simple experiment to answer a question
- Read scientific materials critically.

OUTCOME STATEMENT (Continued)

- Demonstrate a basic understanding of the function of the ecosystem and his/her relationship to it.
- Demonstrate a basic knowledge of the systems of the human body.
- Demonstrate a basic knowledge of physical science concepts to which he/she has been introduced.

1 Each unit will have:
A. A listing of kit and non-kit items.
B. Supplemental materials list.
C. Teacher background information.
D. A schedule.

2 The units have been developed to be taught anytime throughout the year.

3 The approximate times needed for each unit are included to help you in your long range planning.

4 Worksheet masters are included in your guide for reproducing.

5 Call the Science Center if you have a problem.

ELECTRICITY

Grade 3

ELECTRICITY

Grade 3

KIT

Batteries 45 D-cell
Wire - cut
Bulb - 40
Masking tape - 1 roll
Bulb holder - 35
Battery holder - 35
Junk box
4 beakers
Salt
Soda
Comet cleaner
3 boxes paper clips

NON-KIT

Items to test for electrical conductivity.

SUPPLEMENTAL MATERIALS

Grade 3

F-11	ELECTRICITY ALL ABOUT US
F-360	HOW ELECTRICITY IS PRODUCED
F-543	HOW TO PRODUCE ELECTRICITY WITH MAGNETS
F-690	SAFETY WITH ELECTRICITY
F-750	ELECTRICITY AND HOW IT IS MADE
F-1646	ELECTRICAL SAFETY FROM A TO ZAP
F-1690	BOYHOOD OF THOMAS EDISON
F-1970	WHAT IS ELECTRIC CURRENT
F-2259	ENERGY CRISIS
F-2544	I'M NO FOOL WITH ELECTRICITY
F-2612	WIZARD WHO SPAT ON THE FLOOR
F-2614	HOMEMADE ELECTRICITY

BOOKS (Taken from 5th Grade Bib. read first)

ELECTRICITY, Bertha M. Parker, Evanston, Ill., Harper & Row 1963.
ELECTRICTY AND HOW WE USE IT, Tillie Pine and Joseph Levene, N.Y., McGraw Hill 1962.
ELECTRICTY IN YOUR LIFE, Eugene David, Englewood Cliffs, N.J., Prentice Hill 1963.
THE STORY OF ELECTRICITY, Moe and Ira Freeman, N.Y. Random House 1961.
THE FIRST BOOK OF ELECTRICITY, Beryle and Samual Epstein, N.Y., Franklin Watts 1953
YOUR TELEPHONE AND HOW IT WORKS, Herman and Nina Schneider, N.Y., McGraw Hill 1965.
BUILD IT YOURSELF SCIENCE LIBRARY, Raymond E. Bartlett, N.Y., Doubleday Co., 1963.
EXPERIMENTS WITH ELECTRICTY, N.Y., Thomas Y. Crowell Co., 1959.
THE FIRST BOOK OF HOW TO FIX IT, Jane Bendick, N.Y., Franklin Watts 1961.
WOLF CUB SCOUT BOOK, BEAR CUB SCOUT BOOK, LION CUB SCOUT BOOK, N.J., Boy Scouts of America, any addition.

Check with your librarian for more.

Learning Resource Units
UN-59 Electricity and Magnetism

Book Series, 3rd Grade

ELECTRICITY

Grade 3

INTRODUCTION:

The lessons in this unit have been written so that your students will be able to carry out experiments with simple equipment - flashlight batteries, small bulbs, wire of various sizes, nails — and draw conclusions based on their observations of the experiments.

You will probably find it best to divide your class into groups of two and four students. This arrangement will enable the students to work and converse easily as they discover new things pertaining to electricity. The arrangement will also allow you to move from group to group, encouraging the students to answer their own questions by experimentation.

The lessons are designed to allow your students to follow many side paths for experimentation. For example you may have students working on ways to make the light bulb (Experiment I) not shown in the "prediction sheets". Your schedule and the students' interests should be the only limits to this kind of creative work.

It is important for you to have; Lead-Off Questions, Follow-Up Questions, activity experiments and discussion questions, well in mind as you proceed with this unit.

SCHEDULING:

This unit has been designed to take about seven hours of work over a three week period of time. This time period could be broken into 40 minute periods three times each week. This will give you enough time to allow your students to explore some of their ideas as they develop from the unit.

EVALUATION:

It is difficult to design evaluation devices for this kind of experimental science. Activities, such as are described in this unit, will allow your students to move at their own rate, hence individualized evaluation is necessary. Two possible ways of evaluating your students' progress are:

a. Observation - This is the most natural form of evaluation for this unit. As you move from group to group, asking questions and listening to the students, you are in the best position to assess what your students are learning from the lessons. Watch your students closely as they apply what they have learned to new situations.

b. Prediction Tests offer a more formal kind of evaluation. It is possible for you to make test cards similar to the prediction sheets. However, use these only after your students are familiar with the prediction sheets.

SAFETY:

Flashlight batteries are safe for your students to handle. However, you should caution your students not to put more than 12 of the "D" batteries together. There have been instances of people getting slight "tingles" from handling one or more batteries with voltage total of approximately 22 1/2 volts.

Needless to say, caution your students about not (1) trying the experiment they have done in class, at home, with household electricity, (2) detonating flashlight bulbs with a battery, (3) opening an alkaline battery or lead-acid battery which sometimes look like D-cell batteries, because of the dangerous chemicals in them, (4) play with blasting caps which resemble long "AA" batteries.

LESSON I HOW DOES ELECTRICITY LIGHT A BULB

Concept: In order for electricity to flow in a conductor you must complete a circuit.

Materials:

KIT	NON-KIT
Batteries - 1/student Wire - 1/student Bulb - 1/student Masking Tape - 1 roll	None

Procedure:

1. Hand out, to each student, one bulb, one battery, one piece of wire.

(Lead-off Question)

2. Ask, "Can you make the bulb light with one battery and one wire?"

3. Allow the children time to light their bulbs. This will take from 5 to 20 minutes. Once one child gets his bulb to light, his method catches on quickly. When your students have been able to light their bulb move to Step 4.

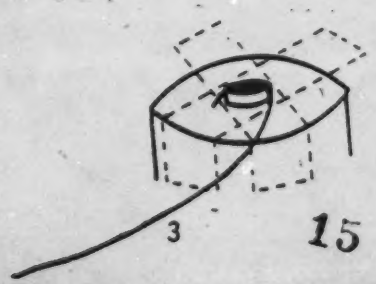
(Follow-up Question)

4. Ask, "How many different ways can you light the bulb?" Have your students draw pictures of their different experiments.

5. Various things you may find your children doing include:

   a. Using two or more batteries to light the bulb (caution them to use 2.5 volt bulb - 1.5 volt bulb will burn out).
   b. Finding out how many bulbs can be lit with one battery.
   c. Finding out that two batteries light the bulb more brightly.
   d. Finding out how many batteries it takes to burn out a bulb.
   e. Finding out if turning the battery around makes another way. (This can be an exciting discovery for many).

NOTE: As batteries are used together, you may find students who want to hold them together with something. Masking tape works well. The following diagram shows a possible procedure.



LESSON II: PREDICTING WITH LIGHT BULBS AND BATTERIES

Concept:

1. In order for electricity to flow in a conductor you must complete a circuit.

2. Prediction, based on previous experiences.

Materials:

KIT

Battery - 1/student
Bulb - 1/student
Wire - 1/student
Masking Tape
Battery holder - 1/student

NON-KIT

Prediction sheet #1

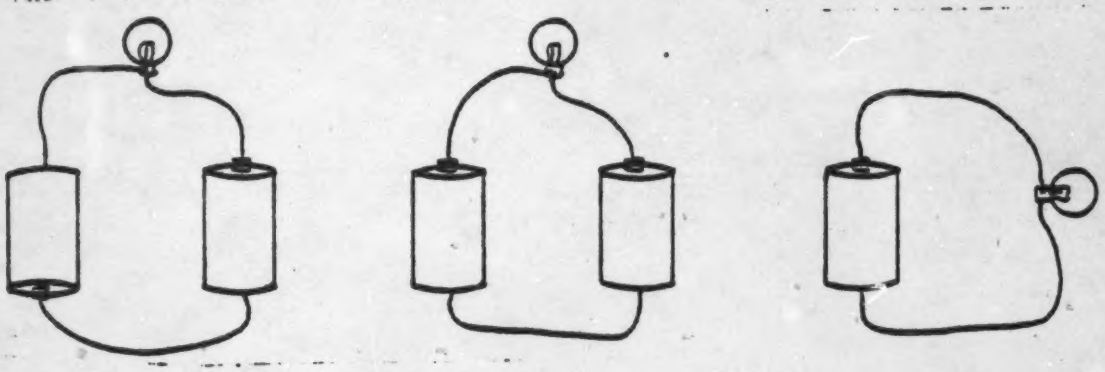
* You will need to run copies of Worksheet #1 for your students.

Procedure:

1. Pass out the bulbs, batteries and wire again.

(Lead-Off Question)

2. Begin this lesson by drawing several different circuits on the board. Ask the class to predict whether the bulbs, in the arrangements shown, will light and why. Examples you can use are:



3. Let the students discuss all their ideas. Have the students try out each of the new circuits to verify their predictions.

(Follow-up Question)

4. Ask, "How many ways did you find to make the bulb light?"

5. Have students draw as many different circuits as they can on the board.

(Follow-up Question)

6. Ask, "Does the bulb have to be touching the battery?"

7. Ask, "Does the wire have to be wrapped around the bulb?"

8. Ask, "What special places must be touched on the bulb for it to light?"

9. Ask, "Will the bulb light if the wire touches the side of the battery?"

10. Ask, "Can you make a "rule" about lighting the bulb?"

(You may want to end the lesson for the day at this point).

11. Pass out prediction sheet #1.

(Lead-off Question)

12. Ask, "Can you predict whether the bulb will light or not in each picture?"

13. When the students have made their predictions, they can hook-up their systems to see if their predictions are correct.

LESSON III SENDING MESSAGES (Optional)

Concept: Electricity can be used to send messages along wires. Because electric current flows very rapidly, these messages travel at great speeds.

Materials:

KIT	NON-KIT
Bulb - 1/student Bulb holder - 1/student Wire - 2/student Battery - 1/student	None

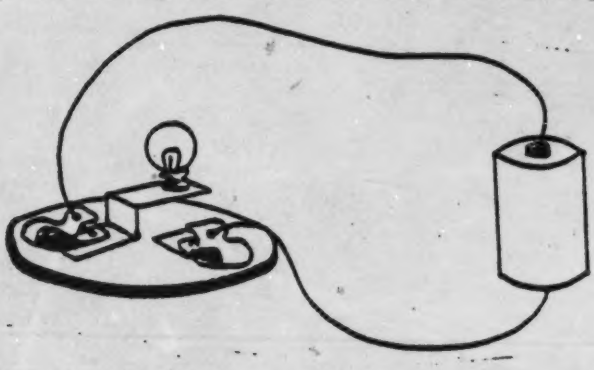
Procedure: This lesson can be used as a means of discussing how electricity can be used to send messages. Your students will have fun blinking their lights at each other. Perhaps someone will suggest that one blink means a certain letter in the alphabet, etc. This can lead naturally into the Morse Code.

This lesson also will give your students a chance to use the Bulb Holder for the first time. This will be used in the next series of lessons.

(Lead-off Question)

1. Ask, "Can you make the bulb light using the bulb holder?"

2. A typical set up will look like the following:

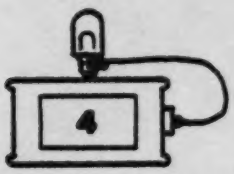


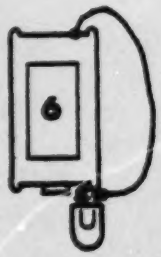
3. Using the circuit set-up, have the students send their messages by touching a free wire end to the battery. Students can devise their own system or you might want to copy the Morse Code on the board.

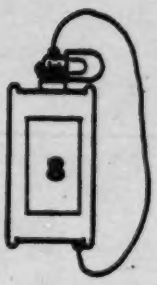
   A real telegraph system makes use of electromagnets rather than light bulbs. However, the sending patterns are the same.

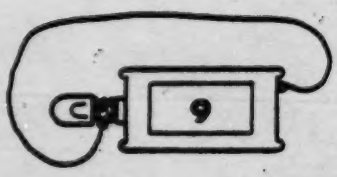
Prediction Sheet 1

Will the bulb light? **If you are not sure, try it and see!**







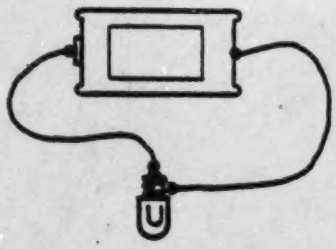


Prediction Sheet 2

In which examples will the bulbs light? Mark a ✓ for those which *will* and an X for those which *will not* light.

1

2



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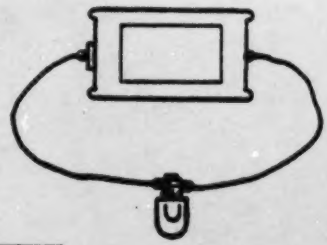

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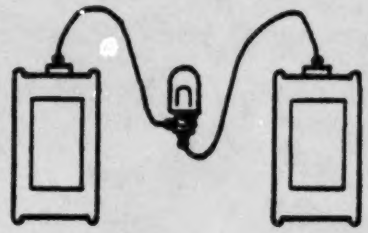

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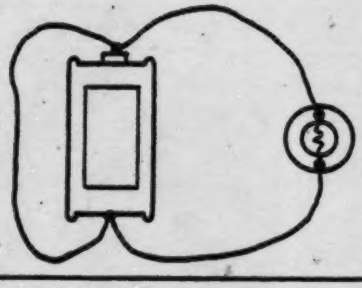

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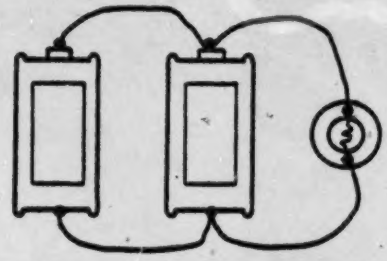

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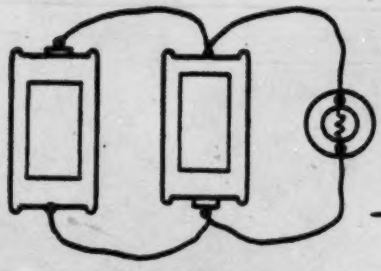

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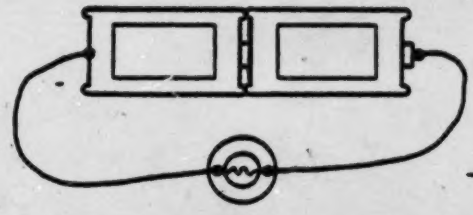

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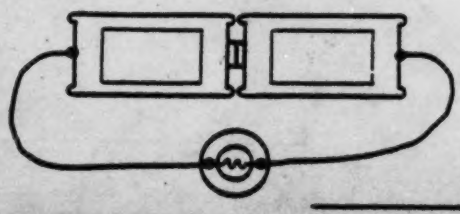

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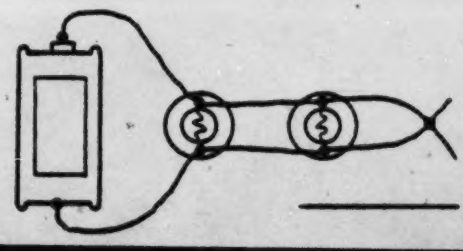
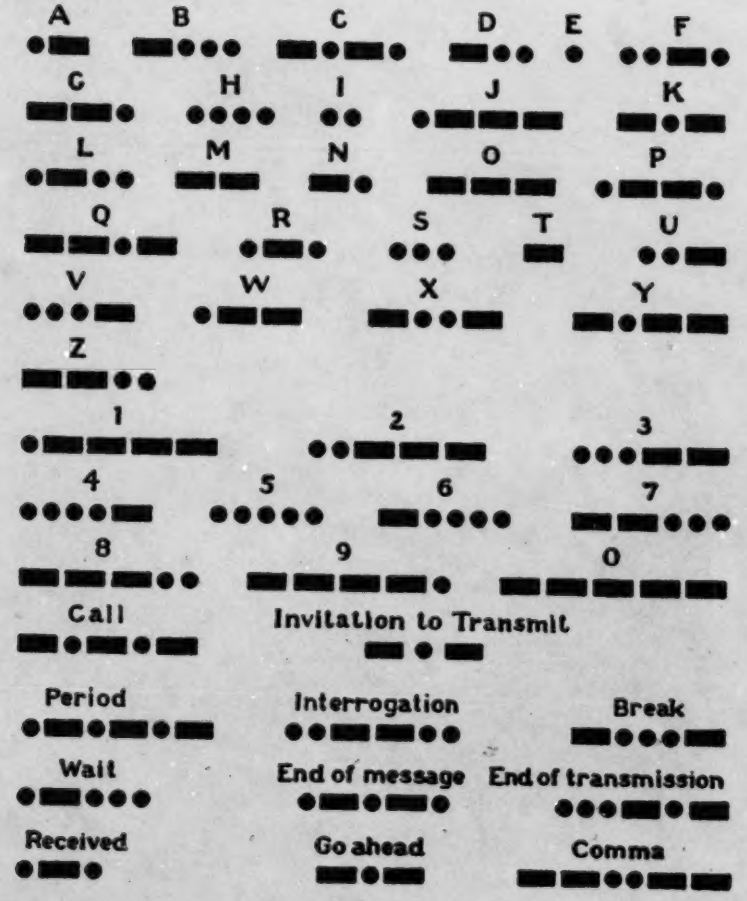


THE CONTINENTAL (International Morse) CODE



LESSON IV WHAT MATERIALS ACT AS CONDUCTORS

Concept:

a. Conductors are materials through which electrons can flow.

b. Non-conductors are materials through which electrons cannot flow.

Materials:

KIT

Bulb - 1/student
Battery - 1/student
Bulb holder - 1/student
Masking tape
Beaker - 4/classroom
Salt
Baking soda
Various objects

NON-KIT

"Junk box" items

* For this lesson you will need a "junk box" of items the students can try. A few are included in the kit.

Procedure:

1. Pass out one bulb, one battery, one bulb holder, two wires, and various "junk items" to each student - e.g. - aluminum foil, tooth picks, nails, thread, etc.

(Lead-off Question)

2. Ask, "What objects can you put in the pathway of the bulb that will allow the bulb to light?"

3. Ask, "What objects will not allow the bulb to light?"

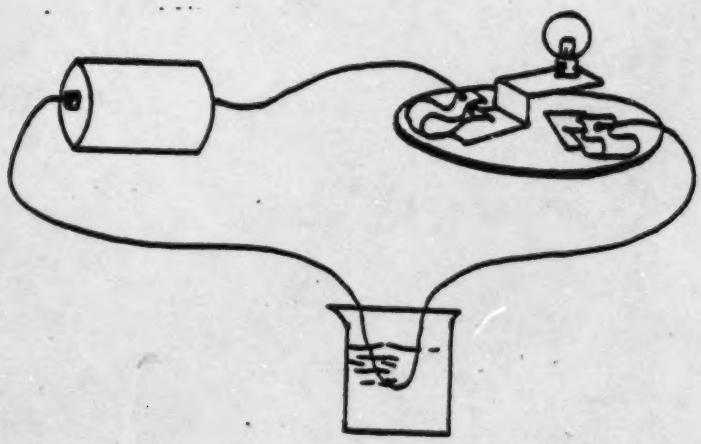
4. It will be necessary for your students to again keep a record. You might suggest the following:

Name of Item	Lights	Doesn't Light

5. You may have your students connecting things into the circuit in different ways. Items may need to be swapped between individuals.

6. Some students may want to try different liquids. This will require some guidance from you. (Students can work in 4 - 6's). Liquids can be very deceptive. One battery doesn't seem to work with any liquid. However, when you add more batteries the bulbs will glow. Four batteries and a strong salt solution will light the bulb immediately.

7. A possible set-up for liquids is shown below. Salt, baking soda, Comet cleaner should be tried.



8. You will see students trying various things to make the bulbs light.

(Follow-up Question)

9. Ask, "Do we have any materials on both lists?"

10. Ask, "Will a second battery complete the path? Does it have to be a <u>live</u> battery?"

11. Ask, "Does the bulb glow with the same brightness with each material that does complete the path?"

LESSON V — SOME WAYS OF CONNECTING BULBS

Concept: There are two basic ways of connecting bulbs in an electrical circuit. (Series and Parallel)

Materials:

KIT	NON-KIT
Bulb holder - 1/student	None
Batter - 1/student	
Bulb - 1/student	
Wire - 3/student	
Masking tape	
Battery holder - 1/student	

Procedure:

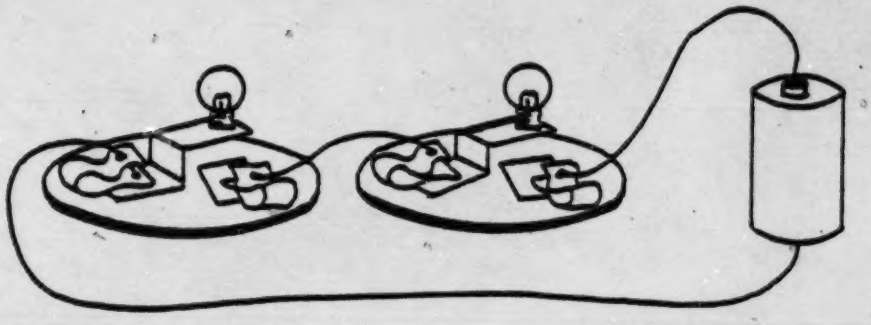
1. Pass out one bulb, one battery, one bulb holder, two wires to each student.

2. Arrange for your students to work in pairs.

(Lead-off Question)

3. Ask, "Can you light two bulbs with one battery?"

4. Allow some time for students to set up the experiment. Most students will set up a series circuit. In a series circuit all of the electricity passes through all parts of the circuit. Such a circuit looks like the following:



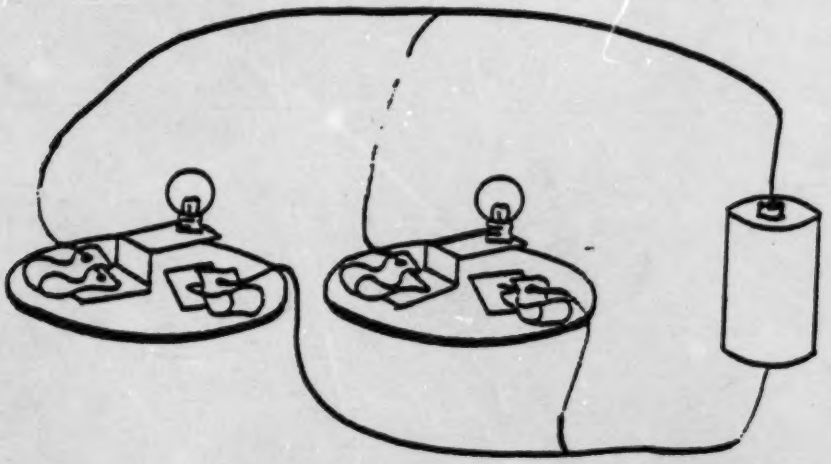
(Follow-up Question)

5. Ask, "What happens if you unscrew one of your bulbs?" (If the students have constructed a series circuit the other light will go out).

6. Ask, "Can you hook-up your bulbs and battery so that both lights don't go out when one is unscrewed?"

LESSON V SOME WAYS OF CONNECTING BULBS (continued)

7. You may need to work with your groups at this time. In a parallel system the electricity is split along different wires. Such a circuit looks like the following:



8. Your students may want to connect more batteries and bulbs together.

LESSON VI HOW CAN ELECTRICITY BE USED TO MAKE A MAGNET

Concept: Electricity flowing through a coil of wire produces a magnetic field. This magnetic field is capable of picking up certain objects.

Materials:

KIT	NON-KIT
Battery - 1/student Nail - 1/student Wire - 1/student Paper clip - 3 boxes	None

Procedure:

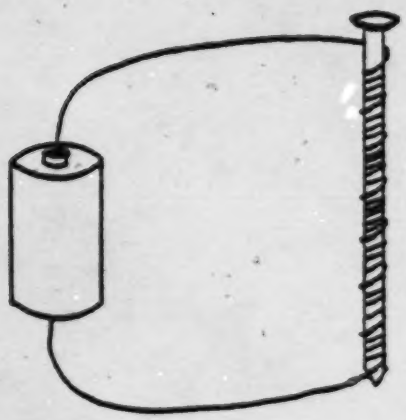
1. Pass out one battery, one nail, several paper clips, battery wire to each student. Students will need to share batteries as the lesson progresses.

(Lead-off Question)

2. Ask, "Can you make a magnet from the materials you have?"

3. Some of your children may have read about electromagnets; hence, they will have an idea of how to proceed, others will not. However, don't rush to answer their questions.

4. The students will need approximately 50 turns of wire around the nail. If they begin winding the wire from the head of the nail the magnet will work out better. You find that more than one battery is necessary. One possible design is shown below.



LESSON VI HOW CAN ELECTRICITY BE USED TO MAKE A MAGNET (continued)

5. Ask, "How many paper clips will your electromagnet pick up?"

6. Ask, "How can you make your electromagnet lift more paper clips?"

7. Ask, "What happens when more batteries are used?"

8. Ask, "Does the type of wire make a difference?"

9. Ask, "Where is the best place on the magnet to pick up the paper clip?"

LESSON VII HOW DO WE USE ELECTRICITY

Concept: Electricity is a power source which is very important in our society.

Materials:

KIT	NON-KIT
None	None

Procedure:

(Lead-in Question)

1. Ask, "What would our lives be like without electricity?"
2. Some students may describe what life was like before the discovery of electricity.
3. Remind the students that in November, 1955, New York City was completely without lights for a number of hours. People were caught in elevators, up in buildings, in subways, hair dryers, etc.

(Follow-up Question)

4. Ask, "What strange situations might take place if you were caught with no lights or power in New York City?" "What would you do?"
5. Ask, "What could people rely on for information if they had no electricity?" (Transistor Radios?)
6. What might happen if all the electricity went out in Anchorage? In the summer? In the winter? (It did after the 1964 earthquake).
7. Perhaps your students could find articles on how we use electricity, or develop a bulletin board on electricity.

FORCE-MOTION AND MACHINES

GRADE 3

FORCE-MOTION AND MACHINES

GRADE 3

KIT

17 30 cm. metric rulers (rigid)
String
17 egg beaters
30 large lag screws
Wedges
Cardboard squares 2" x 2"
Nails
Pins
120 marbles
30 meter sticks

NON-KIT

Books
Bicycle
Masking tape
Scissors
Various pointed articles

SUPPLEMENTAL MATERIALS

FILMS:

F-443	MACHINES THAT MOVE EARTH
F-699	MAKING WORK EASIER
F-537	ENERGY AND WORK
F-569	YOU AND MACHINES
F-695	MAKING THINGS MOVE
F-714	ENERGY AND POWER
F-716	LET'S LOOK AT LEVERS

BOOKS:

MACHINES - O'Brien, 1968
WHEELS - Owen, 1968
MACHINES - Follett Series
TOYS - Parker
DOING WORK - Blough
WORKING WHEELS - Weber
WHAT IS A SIMPLE MACHINE - Darby
HOW AND WHY WONDER BOOK OF MACHINES - Notkin
GOLDEN BOOK ENCYCLOPEDIA - Vol. 9, page 833
FRICTION ALL AROUND - Pine
SIMPLE MACHINES AND HOW THEY WORK - Sharp
THE WORLD OF PUSH AND PULL - Ubell
FRICTION - Follett Series

FORCE-MOTION AND MACHINES

INTRODUCTION:

A stunting airplane hurtles itself towards the earth and then climbs upward again. A car screeches to a stop. A rocket, pushed skyward towards the moon, accelerates faster and faster. A person moves a huge tree off the road. A boy and girl ride their 5-speed bicycles up a hill.

It is with these things that this unit deals.

Force and Motion are two of the most important quantities necessary in all of science. The description and measurement of some type of force and motion is necessary in every branch of science. Consequently, we must make sure that we understand clearly how forces act, in relation to other forces and how motion generated by forces operate.

TEACHER BACKGROUND:

FORCES:

Forces are the pushes and pulls exerted on matter: the pull of a magnet on a piece of iron, the pull of a child on a wagon, the push of a bat against a ball, the gravitational pull between the earth and all objects on or near the earth. A force has magnitude and direction, and an arrow is used to describe these characteristics. The head of the arrow points to the direction of the force and the length of the shaft represents its magnitude.

Forces always produce or prevent motion and are always accompanied by opposing forces or by forces arising from related events. In other words, a force can put in motion an object at rest, change the speed of the object and/or the direction of the object which already is in motion, or stop an object which is in motion. When two or more forces act on an object, it reacts as a result of the combined forces. (Two cars running together).

Friction is a force which acts between moving surfaces. All moving objects on the earth are subject to friction. Although the negative aspects of friction are frequently stressed, it should be remembered that the simple action of walking is impossible without it.

MOTION:

When you travel from home to school you undergo a change of position or what the scientists call displacement. You change your position on the earth's surface (relative position). Suppose you are asked, "How do you go home from school?" and you answer, "I walk nine blocks." Obviously you have not completely described how you made your trip. You have mentioned how far, but not the direction. Thus, displacement must have both direction and magnitude.

Both direction and magnitude are relative quantities. One must always describe them in relation to something. For example - the watch hands move, due to a force. The hands have specific positions relative to each other and to the reference frame, the numbers on the watch. The watch, furthermore, is in a motion relative to the background. We, as the observer, are reading the watch as if we are on the watch dial. Have you ever found yourself in the following conversation?

BILL: Jim, do you see the blackbird sitting in that tree over there?"

JIM: "What blackbird? In which tree? Where?"

BILL: "In that big, scarred tree over there (pointing his finger)".

JIM: "Oh, that tree in front of us! I see it but I don't see the blackbird."

BILL: "On the branch --- etc., etc."

As you can see, before a line of communication could begin, a frame of reference had to be established.

MACHINES:

A machine is any object that allows us to do work with less effort; less, that is, then if we did the job with nothing but our own bodies. You may have to strain yourself to lift a heavy weight by hand; yet you can often push the weight up an incline plane such as a ramp, or lift it with a block and tackle pulley very easily. THE AMOUNT OF WORK YOU DO IN ALL THREE CASES IS EQUAL, but the incline plane and pulley permits you to use less effort; therefore, it is a machine.

Even the simplest machines save us a great deal of time and effort. Try to crack a walnut with your fingers, or open a can of food without a can opener. Without using a machine they become quite difficult tasks.

Machines will not work by themselves. The power, or force to make the parts move must come from outside the machine. A nut cracker and can opener does work only when you use the power of your hands.

A machine does work only when its parts move, no matter how short a distance they move. If a man-made device does not have movable parts nor the necessary power to move its parts, it is not a machine.

A person works exactly the way a machine works whenever he or she lifts something, walks up stairs or uses up energy to do something. Your physical strength or energy is the force, or power to produce motion, and your arms and legs are the movable parts.

Suppose you want to get to the top of a mountain or large building.

Obviously, you can't jump, so you use the switchback trail or the stairs. It will take you much longer by going this way but you won't need to exert nearly the amount of energy (force) as you would by jumping.

Machines do their work in the same way.

In order to do a lot of work you must do it gradually, but the interesting part is that by using a little force over a long distance you can produce great force over a short distance.

Except for a small amount of energy that is lost through friction of the moving parts rubbing together, the work that a machine will produce always equal the work put into the machine -- hence -- perpetual motion is impossible. You cannot get more from a machine that you put into it.

The WHEEL is the simplest and by far the greatest of man's inventions. The wheel and axle, the straight shaft through the center of the wheel on which it rotates, are a single unit. One is useless without the other, and they work together as one device to run our present-day world. It is the basis for all engines and motors. A gear is a wheel with teeth. By varying the number of teeth in a gear wheel, we can make one wheel turn more quickly or slowly - thus increasing or decreasing speed. By using a system of gear wheels it is possible to get great speeds or lift heavy loads with very little effort (racing cars and heavy dump trucks).

The PULLEY is a wheel and axle in its simplest form. By using many pulleys, you can lift great weights with very little physical effort. But the law of machines, the more pulleys you use, the more slowly the weight will be lifted.

The second type of all machines and by far the easiest to understand is the LEVER. A simple lever is nothing more than a long bar balanced at or near its center, like a see-saw. The point on which the see-saw turns, or is balanced, is called the FULCRUM: the distance from either end to the fulcrum is called the LEVER ARM. All levers move up and down on a fulcrum and all have lever arms.

A person weighing little on the long end of a see-saw can balance a heavier person on the short end because of the same rule of machines we already know: A little effort over a long distance equals the same amount of work as a greater effort over a short distance.

LEVERAGE simply means that the longer the effort arm is, the more resistance you will be able to overcome with the same effort.

Every lever must have a fulcrum, or turning point, an effort arm where force is exerted, and a resistance arm; but the fulcrum, the effort and the resistance may be in different positions with relation to one another. There are three major classes of levers.

In a lever of the FIRST CLASS the fulcrum is always between the effort (force) and the resistance (load). Scissors, the see-saw and balance scales are examples of this kind of lever. In a lever of the SECOND CLASS the resistance (load) is always between the fulcrum and the effort. The wheelbarrow, nutcracker and paper cutter are examples of this lever. The longer the arms of the nutcracker the greater will be its squeezing force.

In a lever of the THIRD CLASS the effort is always between the fulcrum and the resistance (load). The shovel and forearm are examples of the third class lever.

Levers can be any one of these three classes of combinations of two or all of them. Compound levers like the hammer of a piano are quite complicated. By a combination of various compound levers your weight can be balanced by a little piece of iron weighing less than a pound. This is what happens when you weigh yourself on the scales.

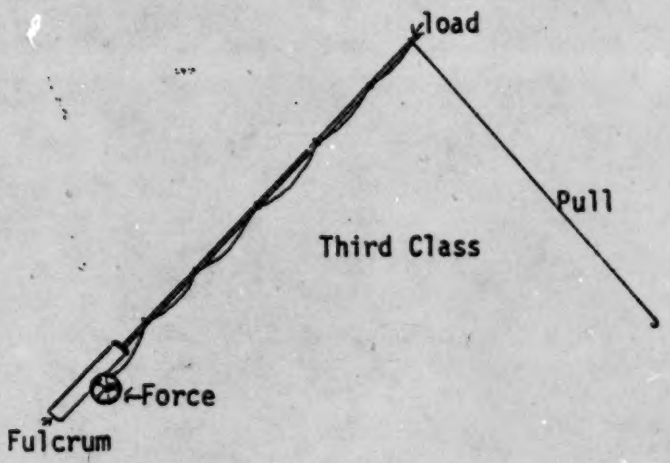
The third type of machines is the SCREW. The Greek scientist, Archimedes, is credited with its invention when he used it to raise water from the sea to the deck of a ship.

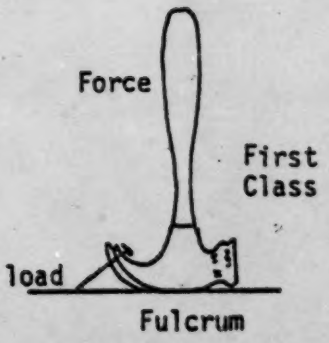
When a screw is turned with a screw driver, the threads move slowly up or down. A screw is simply a spiraled incline plane and again a little effort over a long distance can lift a great weight over a short distance — the smaller this distance is, the greater will be the lifting force. A house can be lifted off the ground by using jackscrews to raise it. A vice can tighten and hold far greater pressures than any human muscle can produce.

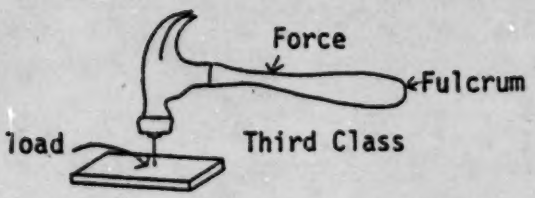
The FOURTH and last type of machine is a thin piece of wood or metal with sloping sides, which we call a WEDGE. The general rule that applies to all wedges is "THE GREATER THE LENGTH OF THE WEDGE IN RELATION TO ITS THICKNESS, THE EASIER IT IS TO DRIVE IT THROUGH A RESISTING BODY". Because of this function, the wedge is the basis of all cutting tools such as the ax, the chisel, the razor blade and the knife. Needles and pins are also wedges.

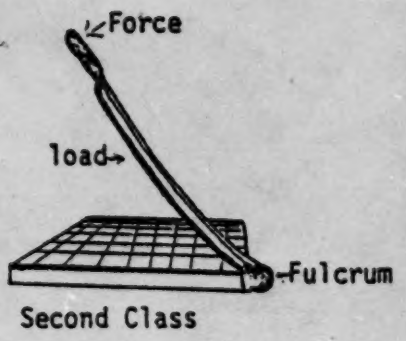
These four basic types of machines -- the wheel and axle, the lever, the screw and the wedge, can be applied to machines in an endless variety of ways. There is not a machine in the world that does not make use of one or more of these basic principles. The more complicated the machine, the more these principles are varied and combined.

Here are some examples of the three classes of levers:









LESSON I: FINDING THE EASIEST WAY TO LIFT A LOAD

Concept: To observe that the farther away from the fulcrum the force is, the less force will be needed to lift an object.

Materials:

KIT	NON-KIT
30 cm. rulers	Pencils
	Books

* You will need copies of worksheet #1 for your students.

** On the worksheet is a picture of a simple machine being used to lift a book. Notice that the fulcrum is near the load or book. In this position it is quite easy, with very little effort, to lift the book. If, however, you move the fulcrum (pencil) towards the end of the ruler where the force is being applied, it takes much more effort to lift the book.

Procedure:

1. Pass out worksheet #1. Have the students set up their equipment similar to the picture being certain that the pencil is under the 2" mark and the book is on the 1" mark.

2. After explaining the words: FULCRUM, FORCE and LOAD, tell the students to press down on the end of the ruler and decide whether it was easy to do or if it took a lot of effort.

3. Next have the students record their conclusions on the form at the bottom of the sheet by circling one of the four words: VERY LITTLE, EASY, HARD, VERY HARD.

4. Next have them move the fulcrum (pencil) to the 4" mark and repeat the investigation and record.

5. Continue moving the fulcrum position until they have completed the worksheet form.

6. After completing this form discuss with the class their conclusions seeing if they understand the concept.

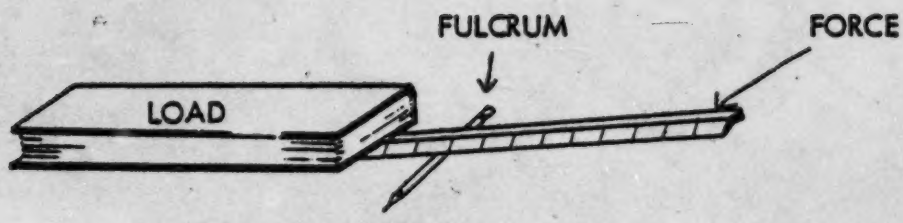
7. You might let them experiment by moving the book to different positions and also by pushing down at different places on the ruler. Does it make a difference where you push down on the ruler?

8. Raise the question: "Is there another way we can lift the book besides pushing down"? Guide the children to see that by raising up on the ruler the book can also be lifted. See if they can locate the new fulcrum.

9. Discuss where they might have seen this type of lever before (see-saw, crow bar, scissors, pliers).

WORKSHEET #1

NAME _____



FULCRUM POSITION	FORCE NEEDED TO LIFT WORK (Very Easy, Easy, Hard, Very Hard)			
5 cm.	VERY LITTLE	EASY	HARD	VERY HARD
10 cm.	VERY LITTLE	EASY	HARD	VERY HARD
15 cm.	VERY LITTLE	EASY	HARD	VERY HARD
20 cm.	VERY LITTLE	EASY	HARD	VERY HARD
25 cm.	VERY LITTLE	EASY	HARD	VERY HARD

LESSON II: FINDING ANOTHER WAY TO LIFT A LOAD

Concept: To demonstrate the use of a second class lever.

Materials:

KIT	NON-KIT
Ruler	Books
String	

* You will need copies of worksheet #2 for your students.

** This experiment is similar to lesson #1 only this time we are using a second class lever with this load between the fulcrum and the force. In this case the distance between the fulcrum and the force doesn't change so it's the distance between the load and the force that makes the difference — the closer this load is to the force the harder it is to lift the book.

Procedure:

1. Pass out worksheet #2 and have the students set up their equipment similar to that on the worksheet.

2. Start with the book hanging from the 5 cm. mark and have the class record the effort needed.

3. Continue moving the book up the ruler until they have completed the worksheet.

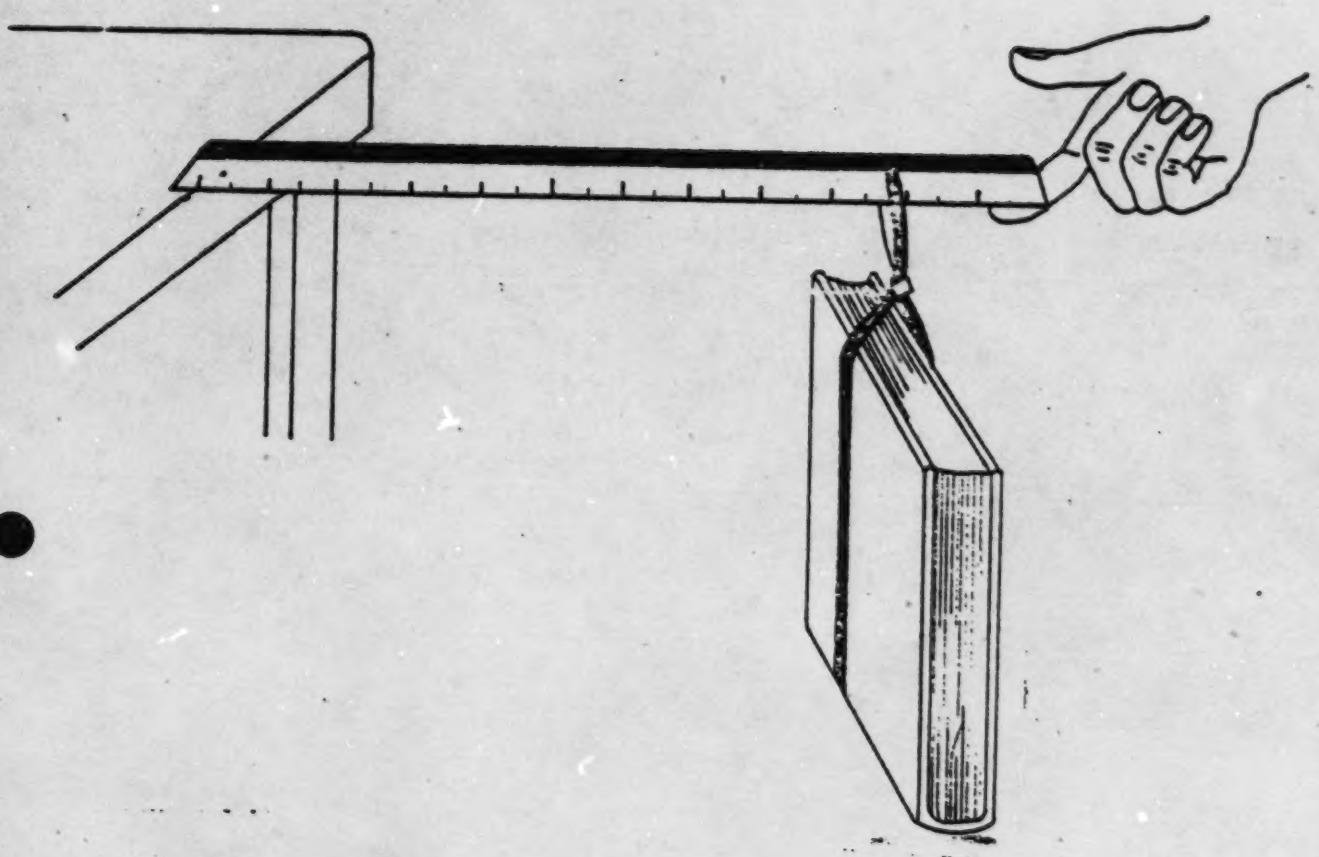
4. After completing the form discuss with the class their conclusions.

   a. At which place did you need the least force to lift the book?
   b. At which place were you able to lift the book the highest?
   c. Where is the fulcrum?
   d. Did the ruler help to add to the force?

5. Discuss where you might have seen this type of lever, but most students won't see the connection. Example: wheel barrow, paper cutter, nut cracker.

WORKSHEET #2

NAME _____



BOOK POSITION	FORCE NEEDED TO LIFT BOOK (VERY LITTLE, EASY, HARD, VERY HARD)
5 cm.	
10 cm.	
15 cm.	
20 cm.	
25 cm.	

LESSON III: ROLLERS MAKE IT EASIER TO MOVE A HEAVY LOAD

Concept: To understand that friction is a force.

Materials:

KIT	NON-KIT
String	Pencils Objects with wheels

* You will need copies of worksheet #3 for your students.

** Because of the gravitational pull of the earth, a great effort is needed to carry heavy objects. If we slide the object the task is easier because we no longer need to counteract gravity although we are working against friction. By placing the objects on rollers, we reduce this friction because roller or wheel friction is much less than sliding friction.

*** Let the children find out for themselves that sliding and rolling things is easier than carrying them.

Procedure:

1. Pass out the worksheet #3 and a rope sling to each pair of students. Have them slip the rope sling around the heaviest book they can find. (A dictionary or maybe even two smaller books).

2. Referring to Figure "A", ask the students to lift the book and record the amount of force needed by circling one of the four available responses.

3. Continue on with Figure "B" and "C" and record responses. On Figure "C" use round pencils first. You might let them try 6-sided pencils for a comparison.

4. Try other objects. Roller skates, toy cars.

5. Repeat "A" and "B" using an incline plane (a board or book) tilted up to show them that pulling up-hill is easier than lifting but harder than pulling on a flat surface.

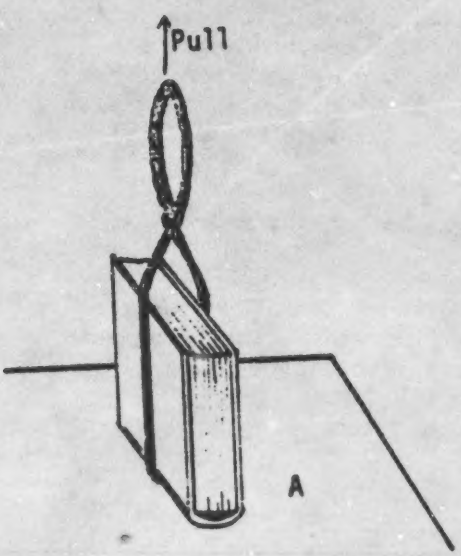
(Discussion Question)

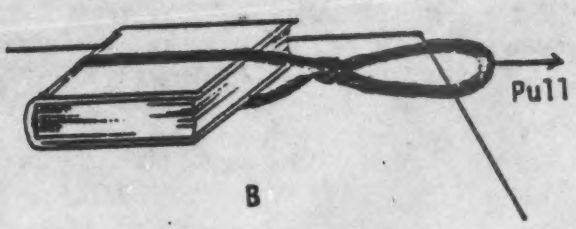
6. In discussing their responses, ask "Why?" Bring out the words FRICTION and RESISTANCE, and suggest ways of lessening friction. Oil, smoothing, using hard materials (diamond, hard steel) etc. Less surface (Hydro foils and Hydro planes).

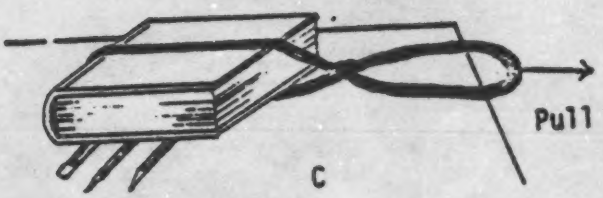
WORKSHEET #3

NAME _____

WHAT IS THE EASIEST WAY TO MOVE THE BOOK?







	FORCE NEEDED TO MOVE BOOK (VERY LITTLE, EASY, HARD, VERY HARD)			
A. Lifting book	VERY LITTLE	EASY	HARD	VERY HARD
B. Pulling book	VERY LITTLE	EASY	HARD	VERY HARD
C. Rolling book	VERY LITTLE	EASY	HARD	VERY HARD

LESSON IV: DO GEARS MAKE YOUR WORK EASIER?

Concept: To understand that using gears increases speed.

Materials:

KIT	NON-KIT
Egg beater	Bicycle
	Masking tape

* You will need copies of worksheet #4 for your students. In this lesson we are trying to get the children to see the advantage of using gears. Lead the children to see that to gain the mechanical advantage (ease of effort) more distance must be covered. You must turn the egg beater about five turns to get one turn of the blades. Some of the children might have ridden a bicycle with gears and can relate how much faster but easier you had to peddle in the higher gears.

Procedure:

1. Give each pair of students an egg beater and a marking pencil (or tape).

2. Have them make a mark on one of the blades of the beater and then turn the handle slowly. How many times does the blade turn while the handle turns just once? One partner will count while the other one will turn.

(Lead-off Question)

3. Ask the question: "Why do we use the egg beater when we have to turn it so far?"

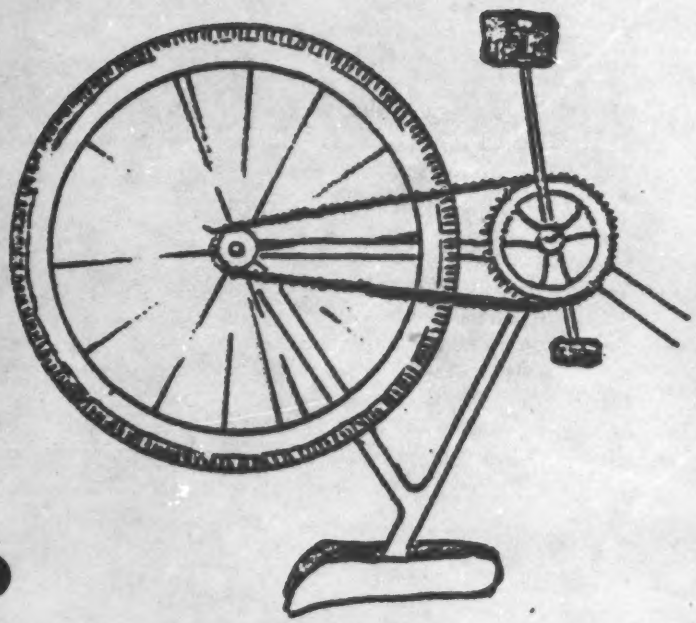
   Find one student that has brought to school a multi-gear (some up to 14 gears) bicycle and ask the student to let you use the bike for the next experiment.

4. Place the bicycle on a desk with the wheels free to rotate (upside down).

5. Mark a spot on the wheel (tape), then see how many turns of the peddle it takes to cause the wheel to rotate once. You will need to put some restraint on the wheel so it will not spin freely.

WORKSHEET #4

NAME _____



BLADES

HOW MANY TIMES DOES THE BLADE TURN WHILE THE HANDLE TURNS JUST ONCE? (TRY THIS THREE TIMES)

1st Trial _____ blade turns

2nd Trial _____ blade turns

3rd Trial _____ blade turns

LESSON V: A SCREW IS AN INCLINED PLANE

Concept: To understand that a screw is a simple machine.
To understand that a screw is a special kind of inclined plane.

Materials:

KIT	NON-KIT
30 large lag screws	Scissors

* You will need to provide worksheet #5 for your students.
** Although the screw is a modified inclined plane. Some children may have difficulty understanding how a screw resembles an inclined plane.

Procedure:

1. Start this lesson by letting each child handle a screw. Have each trace with his or her finger the screw threads from the tip upwards. Guide them into seeing the thread path is similar to climbing a mountain or at least going up-hill.

2. On worksheet #5 have the children color in the strip marked "COLOR", then cut out the triangles and wind it around a pencil. The colored mark will show up as the threads.

3. Next have the students unwrap the pencil and look again at the colored edge. Which direction does it go?

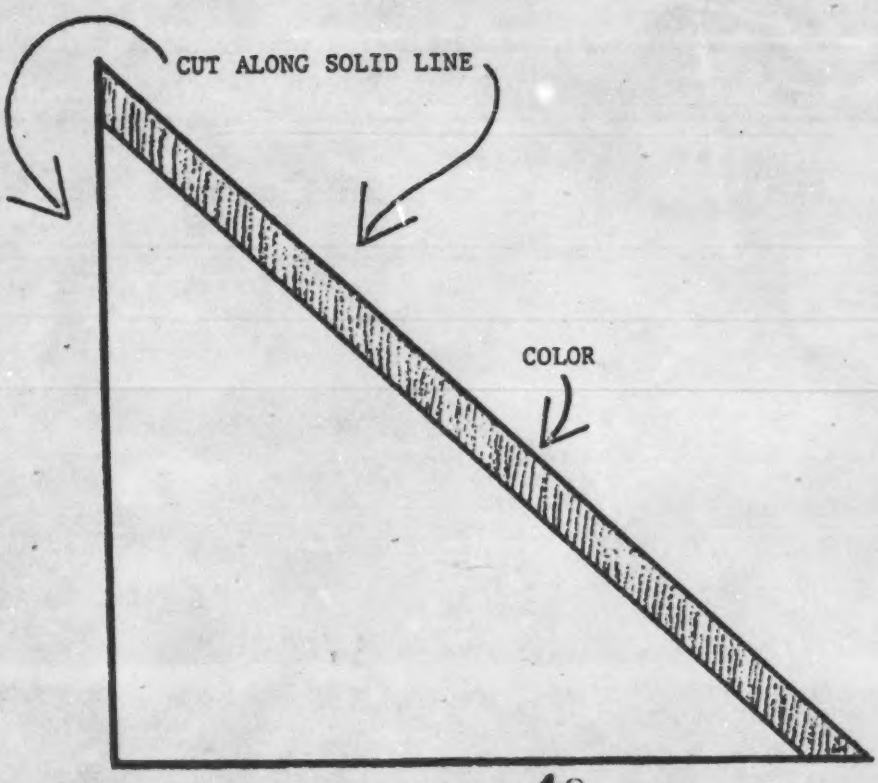
WORKSHEET #5

NAME _____

HOW IS THE SHAPE OF A SCREW THREAD LIKE A ROAD UP A MOUNTAIN?

DOES YOUR WRAPPED PENCIL LOOK LIKE THIS?

HOW IS THE SHAPE OF A SCREW LIKE A ROAD UP A MOUNTAIN?



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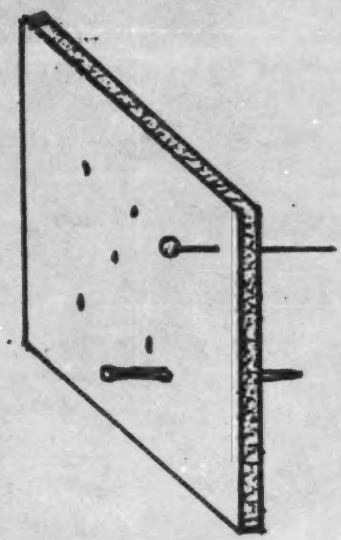
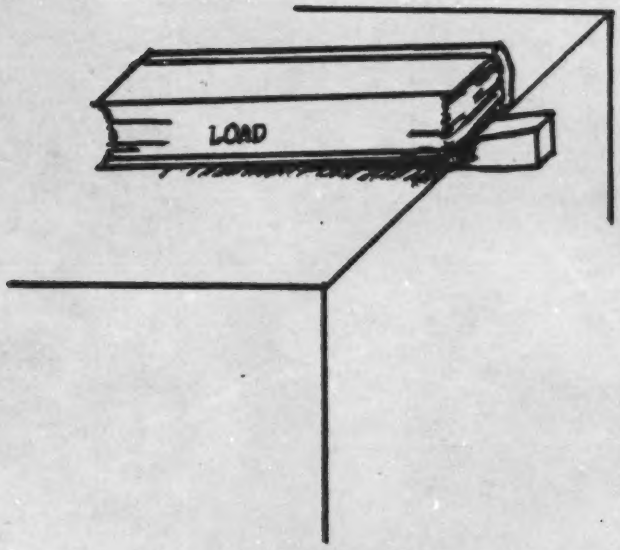
WORKSHEET #6





WEDGE TO BE USED	FORCE NEEDED TO LIFT BOOK (VERY LITTLE, EASY, HARD, VERY HARD)
SHORT WOODEN WEDGE	
LONG WOODEN WEDGE	

	FORCE NEEDED TO PUSH INTO CARDBOARD			
FLAT NAIL	VERY LITTLE	EASY	HARD	VERY HARD
STRAIGHT PIN	VERY LITTLE	EASY	HARD	VERY HARD
POINTED NAIL	VERY LITTLE	EASY	HARD	VERY HARD
SCREW	VERY LITTLE	EASY	HARD	VERY HARD

LESSON VI WHICH WEDGES ARE EASIEST TO DRIVE

Concept: To understand that a wedge is a modification of the incline plane.

Materials:

KIT	NON-KIT
Wedges	Various pointed objects
Cardboard squares 2" x 2"	
Nails, pins, etc.	

* You will need copies of worksheet #6 for your students.

** The wedge is actually a modification of the inclined plane. Most wedges can be thought of as inclined planes which taper off to a point or a sharp edge. In general, the longer the wedge in proportion to its thickness, the easier it is to drive into an object.

DIRECTIONS: In the kit are a variety of wedges to be used to test the amount of difficulty or force needed to either lift an object or push it into cardboard.

1. Pass out a worksheet, a piece of cardboard and different types of wedges.

2. When pushing the wooden wedges under the book, have one partner hold the book from sliding while the other partner taps the wedge with his fist. This will work best at the edge of the desk, although both go in quite easily. They should be able to see that more effort is needed to push in the shorter one. Have them record their findings.

3. Using the cardboard square, have the students push the different wedges into the cardboard and record their findings on the worksheet.

4. In your discussion guide them into seeing that the longer the wedge in proportion to its thickness, the easier it is to drive into an object.

LESSON VII ONE MARBLE VS. ONE MARBLE

Concept: To demonstrate that force and motion are directly related.

Materials:

KIT	NON-KIT
120 marbles 30 meter sticks	

Procedure:

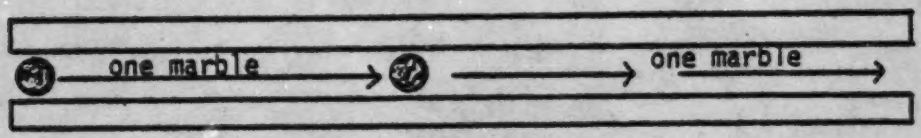
(Lead-Off Question)

1. Have four students line up shoulder to shoulder and facing the class. Ask the class, "What do you think will happen if I push on a student on the end?" Answer will vary, however, you should get the students to realize that the push will cause a motion through the whole group and end person or persons will "fly" off. Push the students to show (sharp push) what will happen.

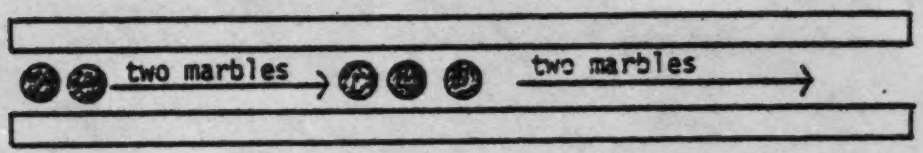
2. Divide the class into 8 working groups. Have the groups tape down their rulers flat on their desks so that they form a groove between them just large enough for the marbles to roll along. Make sure there is no tape in the groove itself. (The rulers are only guides for the marbles and are not used for measuring, since the force the students apply may vary considerably).

3. Have the students set one marble in the groove at about the midpoint of the rulers and then gently roll another marble down the groove from one end so that it hits the midpoint marble. Make sure that the students are rolling the marble gently. Have them practice rolling the marble so that they roll it with the same force each time. When the marbles hit, the students should notice that the rolled marble stops, and the midpoint marbles continues on. Explain that the pushing force they used to roll the marble is transferred to the midpoint marble which then moves on. They could roll the marble, without the midpoint marble being there, to see that their push would carry the marble that far. (There is some loss of energy due to friction, but it can be ignored here.) Tell them that they are now going to experiment further with this transfer of force (transfer of energy).

4. Careful observation is the key to this experiment, but the students will probably be so interested and involved that this will take care of itself. You may want to have your class (or your better students) try to make a written record of the experiment. A pictorial form might work best and might look like figure 1.



and like this for a later one:



5. Once the pictorial representation is established you then might want to record the data in a table form. Such a table might appear as follows:

NUMBER OF MARBLES	NUMBER OF MARBLES HIT	NUMBER OF MARBLES KNOCKED OFF
1		
2		
3		
4		
5		

Many combinations of this can be worked out.

WEATHER

GRADE 3

WEATHER AND CLIMATE

GRADE 3

KIT

30 flasks
30 small funnels
Clay
Food coloring
15 1 hole stoppers
15 glass tubes to fit
1 tube holder
1 12" glass tube
1 hot plate
2 balloons
2 aluminum pie plates
1 large holder
1 beaker
1 candle
1 ring stand
30 straws
Clay
30 thermometers
7 spinners
5 lamp bases
5 bulbs
30 plastic containers
Soil
Small, shiny can
Tongs

NON-KIT

15 pieces tagboard or cardboard
Ice cubes
Ruler

SUPPLEMENTARY DEMONSTRATIONS

Drinking glass
Aquarium
Dry hankie
2 empty bottles
Gallon jug
2 hole rubber stopper
Glass tubing to fit
Balloon
Piece of cardboard

WEATHER

Grade 3

FILMS:

F-373	WAYS TO FIND OUT
F-549	WEATHER SCIENTISTS
F-680	WATER IN THE WEATHER
F-698	WIND AND WHAT IT DOES
F-774	UP IN THE AIR
F-886	RAIN SHOWERS
F-1021	WHAT MAKES CLOUDS
F-1052	CLOUDS
F-1231	SNOWFLAKES
F-1864	COLD FRONT
F-2308	URBAN IMPACT ON WEATHER AND CLIMATE
F-2319	I LIKE CLOUDS
F-2430	TIME FOR RAIN
F-2431	TIME FOR SUN
F-3090	SNOW

BOOKS:

THE WIND - Benedick
THE HOW AND WHY BOOK OF WEATHER - Bonsall
OUR CHANGING WEATHER - Fenton
EXPLORING THE WEATHER - Gallant
ASK ME A QUESTION ABOUT THE WEATHER - Rosenfeld
EVERYDAY WEATHER AND HOW IT WORKS - Schneider
ALL ABOUT THE WEATHER - Tannehill
THE FIRST BOOK OF WEATHER - Wyler

WEATHER

Grade 3

INTRODUCTION:

The term WEATHER is commonly used to refer to the condition of the atmosphere as it affects man's activity on the earth's surface. Weather can be described for a limited locality or for a broad area of the earth. Generally, seven weather elements or individual features of the atmosphere are observed: CLOUDS, PRECIPITATION, TEMPERATURE, WIND, HUMIDITY, PRESSURE, and VISIBILITY. In the first grade unit some work is done with clouds, precipitation, temperature and wind. This unit continues further in this area and introduces air pressure.

No lessons are written, in this unit, on daily weather charting and forecasting. This may become a part of the unit if you wish to plan to do so.

TEACHER BACKGROUND:

CLOUDS:

Water vapor may be carried high into the air by the wind. As the water vapor moves higher, it cools. The water vapor condenses and forms tiny drops. If the drops are high above the ground, they are called clouds. There are three main cloud shapes:

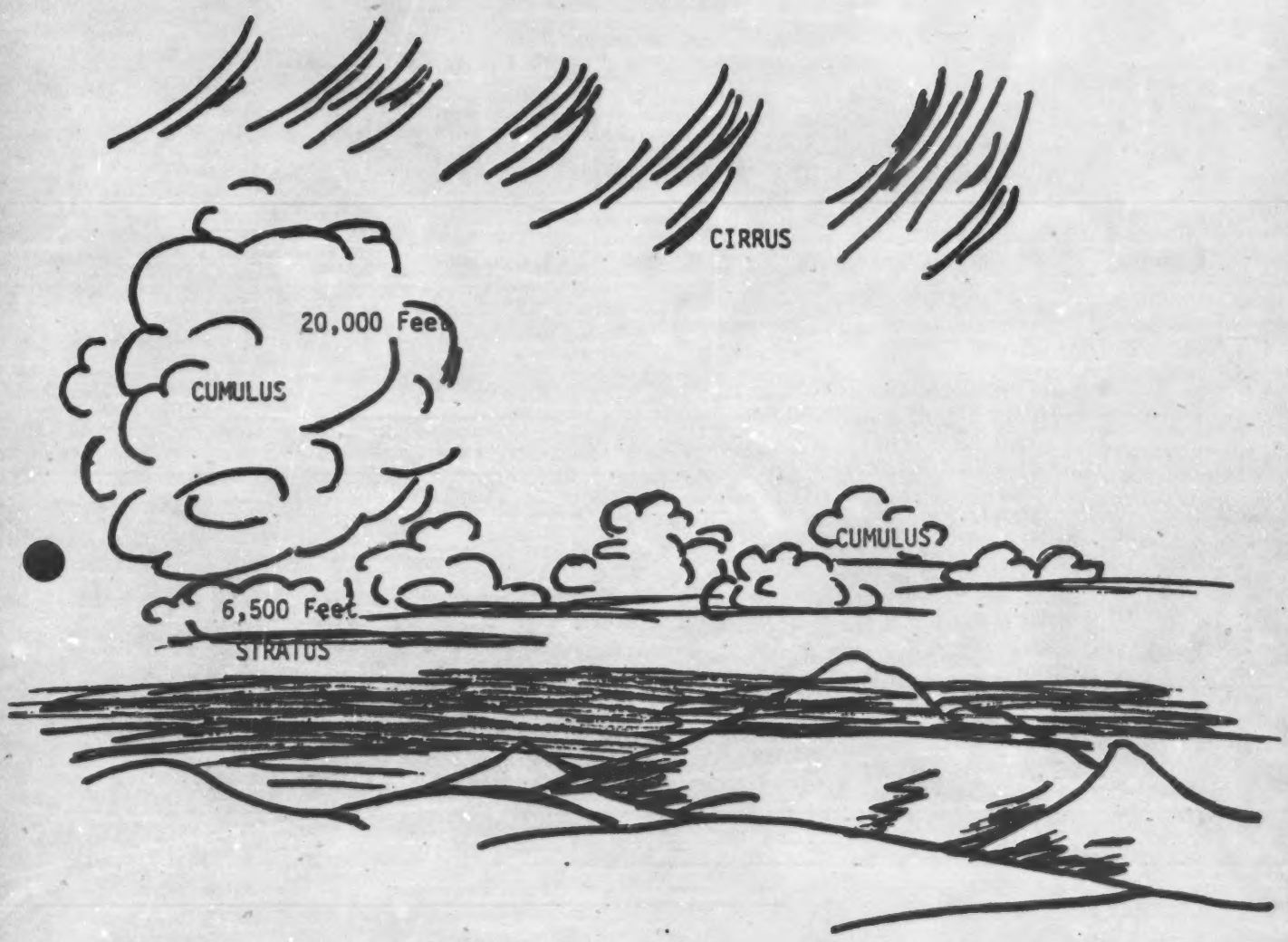
CUMULUS clouds are big and puffy. They are usually fair weather clouds. The word CUMULUS means "heap".

CIRRUS clouds are much higher than Cumulus clouds. They look like feathers or curls of hair. The word CIRRUS is from Latin meaning "curl" or "ringlet". CIRRUS clouds are so high that water vapor condenses as tiny ice crystals. They often mark a change in weather.

STRATUS clouds are straight instead of puffy and rolling. They are in layers. Look for STRATUS clouds at sunset. They form an overcast-looking sky which often turns to rain or drizzle.

Sometimes CUMULUS or STRATUS clouds are gray or black. They look dark and stormy. The whole sky may look gray. In spring or summer, rain may result. In winter, they may bring snow. Clouds are grouped by their shape and also by how high they are.

CIRRUS clouds are high clouds. They are more than 20,000 feet above the ground, up to 40,000 feet high. STRATUS clouds are low clouds. They are less than 6,500 feet above the ground. CUMULUS clouds are found at different distances. Some are low and these are usually fair weather clouds. The bottoms of other CUMULUS clouds are low, but the tops may be over 20,000 feet above ground. These may look dark and stormy. (See drawing on following page.)


CIRRUS
20,000 Feet
CUMULUS
CUMULUS
6,500 Feet
STRATUS

Clouds may be seen in combinations of shapes. To describe the many other kinds of clouds, these three words: CIRRUS, CUMULUS, STRATUS are often used. They are attached to other words, such as ALTO or NIMBUS. ALTO means "medium-height" cloud. NIMBUS usually describes dark, heavy clouds from which rain or snow is falling or is about to fall.

PRECIPITATION:

The presence of ice crystals in a cloud may determine whether or not the cloud precipitates its moisture. Different kinds of precipitation are formed in different ways.

1. DRIZZLE: Drizzle is composed of very small drops (about the size of a typed period sign) which fall from low stratiform clouds or from fog. Clouds that form very small drops are very stable clouds. Large drops come from unstable clouds.

2. SNOWFLAKES: These occur in the beautiful six-sided or hexagonal shapes. Snowflakes form when water vapor accumulates on ice crystals, going directly to the ice stage.

3. SLEET: Sleet forms when raindrops fall through a layer of cold air and freeze. They consist of clear pellets of ice.

4. HAIL: Another kind of frozen precipitation is hail. It usually falls from CUMULUS clouds that have developed into CUMULONIMBUS clouds or thunderheads. Hail consists of balls or irregular lumps of ice. They are either transparent or composed of alternating layers of ice and opaque snow. The layers form as the hail is alternately lifted into a part of the cloud where snow and ice crystals become attached to it and then released into layers composed of water droplets.

PRESSURE:

Many years ago it was recognized that pressure changes accompany changes in the weather, and can often be used to help predict the weather. The pressure, due to the air layer, over any spot on the earth's surface will vary from time to time. Generally it varies somewhere between 14 pounds per square inch to 15 1/2 pounds per square inch.

If the air is warm it does not weigh as much as if it is cold. This is because warm air tends to rise. If it is moist, it does not weigh as much as if it were dry. Many things affect the weight of the air, however the altitude and temperature are major considerations.

A barometer is used to measure air pressure. Two kinds of barometers are in common use. The most common kind is the ANEROID barometer. This instrument has an accordian-like metal box that is sealed and the air taken out of it. This metal box expands and contracts as the air pressure varies. This change is recorded on a dial.

The other kind of barometer is the MERCURIAL barometer. It consists of a vertical tube, closed at the upper end and filled with mercury.

WIND:

When the pressure at one place is different from the pressure at a nearby place air will flow from the higher to the lower pressure, thus creating wind. The larger the pressure difference the greater the velocity of the wind.

Because the earth is rotating, winds do not blow directly from high to low pressure areas. Instead they are deflected toward the right in the northern hemisphere and left in the southern hemisphere.

BRIEF SUMMARY OF FRONTAL WEATHER:

	Ahead of Cold Front	Ahead of Warm Front
Where you are:	In warm air	In cold air
Pressure:	Falling rapidly	Falling steadily
Temperature:	Warm	Cool or cold
Wind:	Strong southwesterly	Easterly
Clouds:	Altocumulus, some cumulus	Altostratus becoming Nimbostratus
Weather:	Swelling Cumulus, showers	Steady rain or snow

	Passing Cold Front	Passing Warm Front
Where you are:	In frontal zone	In frontal zone
Pressure:	At lowest point	At lowest point
Temperature:	Beginning to drop	Beginning to rise
Wind:	Shifting, gusty, south to west	Shifting east to south
Clouds:	Cumulonimbus or Stratocumulus	Nimbostratus, Cumulonimbus
Weather:	Heavy, brief showers, gusty	Heavy rain or snow, sometimes fog

	Behind Cold Front	Behind Warm Front
Where you are:	In cold air	In warm air
Pressure:	Rising rapidly	Rising slowly
Temperature:	Falling rapidly	Becoming warm
Wind:	Strong from northwest	South
Clouds:	Stratocumulus, clearing	Scattered Cumulus, haze
Weather:	Snow flurries, or rain then clear, cold	Warm, humid, occasionally precipitation

LESSON I: SOMETHING GOES IN, SOMETHING MUST COME OUT

Concept: To understand that air takes up space.

Materials:

KIT	NON-KIT
30 flasks	Water
30 small funnels	
Clay	
Food coloring	

* You will need to give each student a copy of Worksheet #1.

** Set out a large container of colored water for their use if no sink is in the classroom.

Procedure:

(Lead-off Questions)

1. Introduce the work in a manner similar to the following: The news reporter (weatherman) says, "Coming up in a minute, the weather forecast for today." People stop, wait and listen. Why? How does weather affect us? Our plans? Our homes? Our clothing? How can the forecaster know what the weather will be? What does forecast mean?

   What is weather? (Weather in this unit is considered to be the condition of the atmosphere.) What is the atmosphere? Air? First then we will need to find out about air.

2. Pass out worksheet #1. The students can then gather the materials necessary to complete the lesson. Give assistance to any pair as they need it.

(Follow-up Questions)

3. After completing the worksheet discuss the results. What happened to Flask A? B? What are some of the things they tried in the last part?

4. Summarize. You have learned something about air. What is it? Does air take up space?

5. If the students still need more help to understand this idea, use one of the following suggestions for a demonstration. (Materials are not included for these activities.)

   A. Lower a drinking glass mouth downward into a vessel of water. It is more effective if a dry handkerchief or a piece of paper has been pushed into the bottom of the glass. This shows very effectively that air occupies space.

B. Fill an aquarium with colored water. Push one "empty" bottle upside down into the water. Hold the bottle with the mouth straight down. Now tilt the bottle. What do you see? Push another "empty" bottle down beside the first bottle. Tilt the second "empty" bottle so a bubble comes out. Catch the bubble in the first bottle. Continue to do this until there is no water in the first bottle. Was either of the bottles "empty"?

C. Take a narrow-mouthed jar such as a gallon jug, and close it with a 2-hole rubber stopper, into which are fitted short lengths of glass tubing. Tie a limp balloon securely over one of the tubes. Connect the other tube to a water faucet with a length of rubber tubing. As you fill the jar with water, the balloon will expand, because air is being displaced from the jar.

WORKSHEET #1: Students must be careful to obtain a proper seal with clay. If they do not, the experiment will not work properly. When the students pour water into the sealed flask, little or no water should go into the flask. This phenomena happens because the air inside the flask can not escape.

WORKSHEET #1

NAME _____

1. Fill one flash with water. This is flask A.

2. Put a funnel in the flask. Put clay around the funnel tightly.

3. Pour water into the funnel. What happens? _____

4. Put a funnel into the flask that does not have water. Put clay around the funnel tightly. This is flask B.

5. Pour water into the funnel in flask B. What happens? _____

6. Find a way to pour water into flask B. What did you do? _____

Why wouldn't water go into flask B the first time? _____

LESSON II: HOT AIR

Concept: To demonstrate that air exerts pressure.
To develop an understanding of how and why a thermometer works.
To show that heat causes air to contract or expand.

Materials:

KIT	NON-KIT
Food coloring	Water
2-3 flasks	2-3 pieces of tagboard or cardboard
2-3 one-hole rubber stoppers to fit flasks	Ice cubes
2-3 glass tubes	
1 tube holder	
1 12" glass tube	
Hot plate	
2 balloons	
2 aluminum pie pans	
1 large holder	
1 beaker	
1 candle	
1 ring stand	

* You may wish to use Activity 3 and 4 as a student demonstration. Use colored water in the demonstration.

Procedure: Have the students who are demonstrating call attention to what they are doing, explaining each step as they go along.

1. Fasten a balloon to the mouth of each flask. Ask, "What is in the flask?" (After Lesson I, each child should be ready to reply: "Air.")

2. Put one flask in a pan of water on the table.

3. Put the other flask in a pan of water on the hot plate. Turn on the hot plate. Ask: "What is the difference between the two flasks?"

4. Observe closely both flasks as the air in the second one begins to heat. (The balloon will expand.)

5. Discuss the results. What happened to each? What could make the difference?

6. Allow the second flask to cool as you observe it. (The balloon deflates.)

7. What happens? Why?

LESSON II: HOT AIR (continued)

* Discuss what caused the air to contract or expand, and why. (The air is made of very small parts called molecules. These molecules are much too small for you to see. All objects are made of molecules. Air molecules are always moving. They are bouncing around in all directions. If the air is heated, the molecules will move faster and bounce farther apart from each other. In warm air the molecules are farther apart than in cold air.)

Have students demonstrate how a thermometer works by making an air thermometer following the directions on the next page. Have them use a candle to demonstrate more effectively how the column rises. They can check the accuracy of the air thermometer using the room thermometer and calibrate if you wish to take the time.

* Discuss: What makes the air thermometer work? Why does the water move up or down? What happens to heated air? Summarize.

WORKSHEET #2: The thermometer will function properly as it is heating up. However, it will not operate as correctly as it is cooling down. This happens because the dissolved oxygen in the water escapes in the heating process and does not return promptly as the flask cools down.

WORKSHEET #2

Name _____

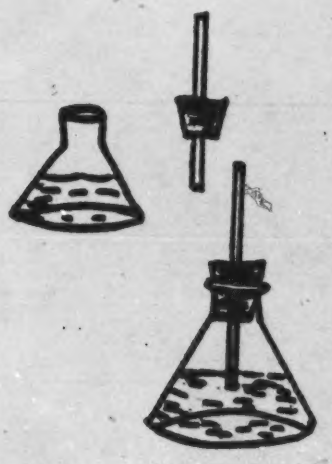
You can make a simple air thermometer. Follow these steps:

1. Put the colored water in the flask until the flask is about 1/2 full.

2. Push the glass tube through the hole in the rubber stopper.

3. Place the stopper in the mouth of the flask.

4. Place your hands around the upper part of the flask. Leave them there a few minutes.



What happens? _____

_____

_____

_____

What might cause this to happen? _____

_____

_____

5. Rub ice cube over top part of the flask. What happens? _____

_____

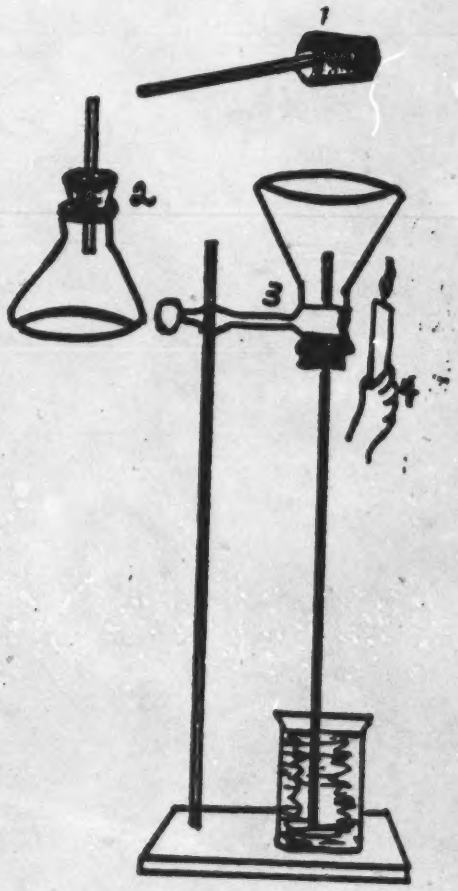
_____

_____

OPTIONAL TEACHER DEMONSTRATION

ANOTHER AIR THERMOMETER

1. Put the 12" glass tube through the rubber stopper (1).
2. Put the stopper into a flask (2).
3. Fill a beaker with colored water.
4. Turn the flask upside down with the end of the tube in the H_2O. Fasten the flask to a stand (3).
5. Hold your hands around the flask to warm it a little.
6. Use a lighted candle to make the flask warmer (4).
7. Calibrate the thermometer using a marking pencil, string, etc. or simply mark it with a string at the day's temperature and check to see that the H_2O level rises or falls as the room thermometer does.



LESSON III: SUCKING UP THE LIQUID

Concept: To demonstrate that air exerts pressure.

Materials:

KIT	NON-KIT
15 flasks	Water
30 straws	
Clay	

* Make sure that each student group has a copy of Worksheet #3.

** Be sure the flasks have been washed and are clean.

Procedure:

1. Pass out Worksheet #3 and materials.
2. Allow each student of the pair to follow directions and complete the experiment using his or her own straw. Compare results. Did the same thing happen each time?
3. Compare class results. Summarize. (When you sucked on the straw the first time some of the air moved out of the straw. Air outside of the container pressed down the water through the space around the straw. The air pushed the water up into the straw. When you sucked on the straw the second time, why were you not able to drink the water? No air could get in to push down on the water.)
4. Introduce the term: AIR PRESSURE.

WORKSHEET #3: Students will have difficulty drawing water from the flask in Step #5. Remember, when the flask is open, air pressure is pushing down on the liquid. When it is closed, air pressure cannot operate on the liquid.

WORKSHEET #3

Name _____

1. Fill the flask about half full of drinking water.

2. Put your straw into the flask. Try to drink the water through the straw.

3. Could you drink the water? _____

4. Use the clay to make the straw fit very tightly.

5. Now try to drink the water through the straw.

6. Could you drink the water this time? _____

7. Did the same thing happen when your partner did it? _____

8. What do you think caused the difference?

_____

_____

_____

_____

LESSON IV: HOT AIR

Concept: To show air currents.

Materials:

KIT	NON-KIT
17 thermometers	None

* Divide the class into groups of two and supply each with a thermometer.

** Draw the chart shown below on the chalkboard.

Procedure:

(Lead-off Questions)

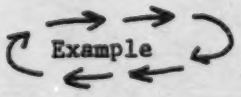
1. Introduce the lesson with: "Can you feel the air?" (Some child will likely start waving his hands and say "yes".) "When can you feel it?" "What is moving air called?" (Wind)

   * Review: "You have seen that warm air is lighter than cold air. Can you think of some way that could cause wind or a change of weather?" "Is air the same temperature (measuring hot and cold areas) and the fact that warm air moves "up" and cold air "down".

2. Have each group be responsible for finding the temperature in one of the following places in the room. Be sure that they hold the thermometer away from themselves.

On the floor	Floor _____°
Near the ceiling	Ceiling _____°
At the window	Window _____°
At the door	Door _____°
Over the radiator	Radiator _____°
In front of the room	Front _____°
At the back of the room	Back _____°

Chart the results and compare. Where is the air the warmest? The coldest? How great is the difference?



LESSON IV: **HOT AIR** (continued)

3. Diagram the flow of air in the room from the temperature readings. (Disregard fan in room heater.)

4. Optional Activity: Allow the groups to go outside and find the temperature in the following places:

   Under a tree
   Out in the open
   Over a sidewalk
   Over the blacktop
   Over grass
   One other place depending on your area.

   Show the results on a chart on the chalkboard as in 2. Was the temperature the same in each place? Where was it the warmest? Coolest?

5. Summarize: Air moves outdoors in much the same way as it moves in a room. Warmer air is pushed up by cooler air.

LESSON V: THE OCEAN AND THE SHORE

Concept: To understand that heat absorption and radiation varies between soil and water and that this is a cause of wind.

Materials:

KIT	NON-KIT
5 lamp bases	Water
5 lamp bulbs	
30 plastic containers	
30 thermometers	
Soil	

* Divide the group into pairs of students.
** Each child will need a copy of the Worksheet #4.
*** Three pairs of students will use one lamp.
**** Make aluminum caps for the five lamps as shown on the worksheet diagram.

Procedure:

1. Pass out Worksheet #4 and materials. Set the lamps in various places in the room and assign pairs of students to use certain lamps. Assist students if necessary. Perhaps you will want to go over the directions on the worksheet with them before they begin independent work.

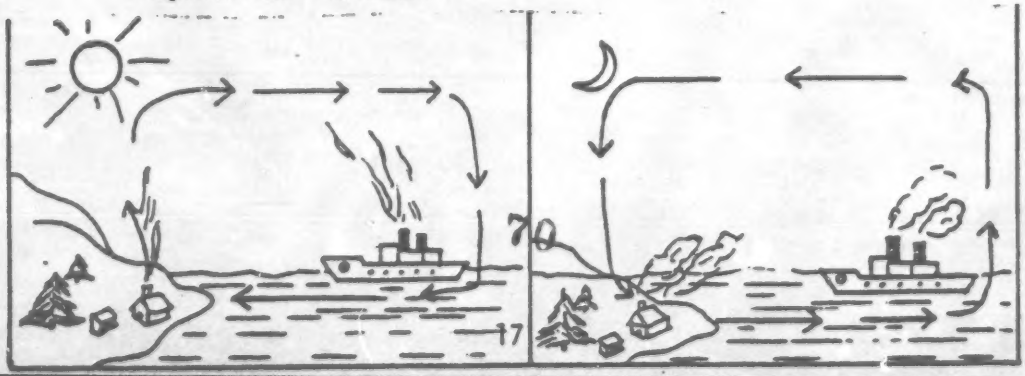
(Lead-off Questions)

2. Discuss the results. Did all groups get the same results? Which heated most rapidly, water or soil? Which cooled most rapidly, water or soil?

   On a hot, sunny day at the beach, which is warmer, sand or water? Does the sand remain hot for long after the sun sets? Are the temperatures of the water at night and during the day very different? Which would cool more rapidly, the beach or the water? When a section of the earth is heated, what happens to the air above that part? What causes currents of air as we have seen on our playground and in our room? (Students should know from previous work that warm air expands and becomes lighter.)

   When a mass of air rises above the earth, what change takes place in the air pressure near the earth?

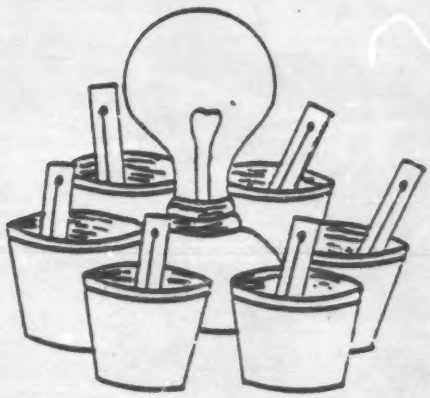
3. Discuss land and sea breezes. Draw an illustration similar to the ones shown on the chalkboard for all to see as you explain and discuss.



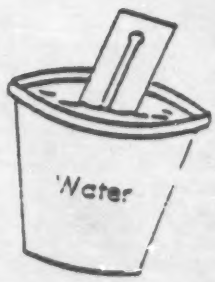
WORKSHEET #4

Name _____

FOLLOW DIRECTIONS CAREFULLY



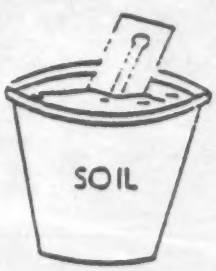
1. Fill one container with soil.
2. Fill one container with cold water.
3. Put a thermometer in each container.
4. Set your containers under the lamp like this.
5. What time is it now? _____
6. Every 5 minutes check the temperature of the soil and the water and record the temperature below.



5 min. _____
10 min. _____
15 min. _____

5 min. _____
10 min. _____
15 min. _____

7. Which one warmed up fastest? _____
8. Turn off the lamp. Be ready to check the temperature every 5 minutes after the lamp is off. Record the temperatures below.



5 min. _____
10 min. _____
15 min. _____

5 min. _____
10 min. _____
15 min. _____

9. Which one cooled the fastest? _____

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LESSON VI: UP IN THE CLOUDS (Optional demonstration)

Concept: To demonstrate how clouds are formed.

Materials:

KIT	NON-KIT
1 flask	Ice cubes
Wooden matches	Tins for burnt matches

* You may want to demonstrate how clouds are formed using the following procedures. As you demonstrate review evaporation and condensation from previous lesson. Next discuss the various types of clouds and weather associated with each. (See teacher background information.)

Procedure:

1. Observe the clouds outside. What kind are they? Do you think these clouds will bring rain?

2. Pass out Worksheet #5 and demonstrate the illustrations on Worksheet #5.

3. (Optional: You may wish to do more work with cloud formations, illustrations of, recording local cloud formations, etc.

WORKSHEET # 5

1. Light a match.
2. Blow it out.
3. Drop it in the flask right away so that its smoke rises.
4. Lay the ice cube on the mouth of the flask.
5. Watch very carefully. What happened? _____

_____

What do you think caused it? _____

_____

_____

Draw a picture below to show what happened.

LESSON VII: WEATHER INSTRUMENTS (An Optional Discussion Lesson)

Concept: To research the instruments used in weather forecasting.

Materials:

KIT	NON-KIT
None	None

Procedure:

1. Briefly discuss each of the following instruments and their work. Use an encyclopedia, science text, or library book on weather for information needed.

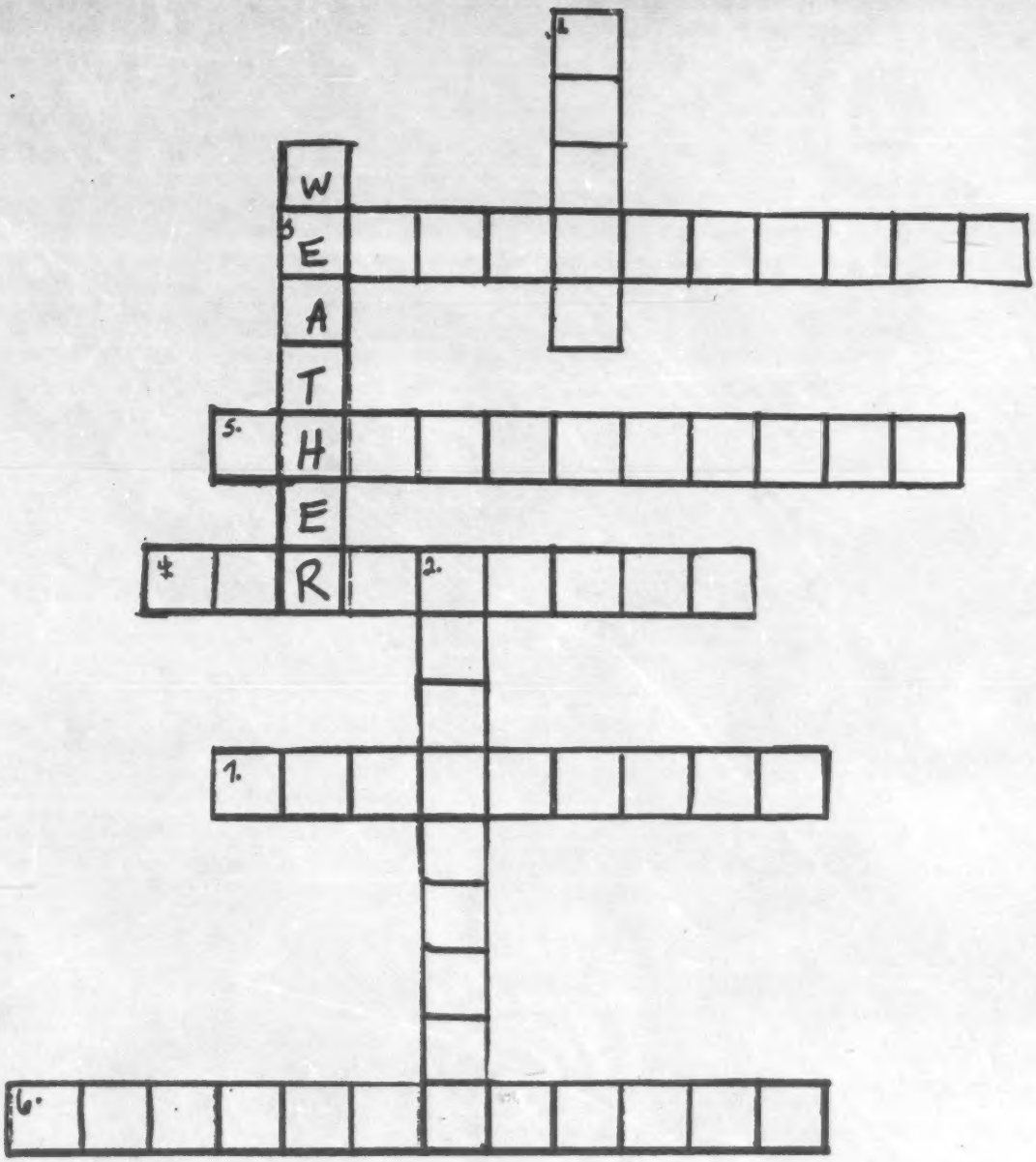
ANEMOMETER	RAIN GAUGE
BAROMETER	WIND VANE
HYGROMETER	RADIOSONDE

2. Discuss the work of the Weather Bureau, and how they use the above instruments to predict weather.

QUESTIONS AND ACTIVITIES TO BE USED FOR EVALUATION OR REVIEW:

1. What are the three main kinds of clouds? Draw a picture of each.
2. What happens to water vapor when it condenses?
3. What is a cloud?
4. Explain how hail stones form. Draw a picture to show this.
5. Why is it easier to pour juice from a can with 2 holes in the top than from one that has only one hole?
6. Suppose that on a very cold day your Mother boils water to make tea. The inside of the kitchen windows become wet and "fogged up". Explain why.
7. How can observing clouds help you predict the weather?
8. How does the sun help make rain?

Complete the puzzle on the next page.



1. WHAT WATER IN THE AIR IS CALLED
2. THE VERY SMALL PART THAT THE AIR IS MADE OF
3. CHANGING OF LIQUID WATER TO WATER VAPOR
4. MEASURES AIR PRESSURE
5. MEASURES AIR TEMPERATURE
6. WHAT WATER VAPOR CHANGING TO LIQUID IS CALLED
7. TO TELL WEATHER AHEAD OF TIME